

Acoustical Signature Analysis for In-Situ Monitoring and Quality Control for In-Space Additive Manufacturing, Phase I

Completed Technology Project (2018 - 2019)



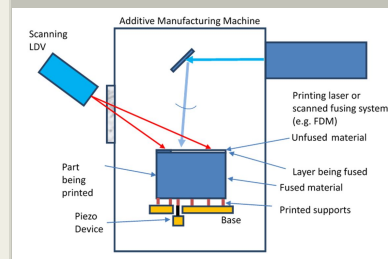
Project Introduction

Parts manufactured by additive manufacturing (AM) typically suffer from a combination of defect types that can inhibit the functional performance of a part. Most AM parts inspection methods are destructive, time-consuming, complex, expensive, do not perform in-situ, and are not easily applicable in space. This Phase I SBIR proposes to develop a non-destructive evaluation method based upon acoustical signatures that can perform in space, in-situ, and post production and is equally applicable to both metallic and non-metallic AM. Laser Doppler vibrometry is combined with vibrational resonance spectroscopy to extract acoustical information from exposed layers during the printing process to characterize the part. The Phase I work will demonstrate feasibility by experiment and computer simulation. Component samples ranging from acceptable to unacceptable will be produced and fully analyzed with complex inspection and diagnostic tools to verify the mechanical and structural properties, and the associated acoustical signatures will be correlated with various stages of contamination and defects. We will determine how well the acoustical signature of a reference part can be used to certify additional parts arising from subsequent production. We will show how such a system can be interfaced with a printing machine and operated in a space environment.

Anticipated Benefits

New NDE methods will find extensive application to inspect and distinguish substandard components in additive manufacturing on earth and in space and would be a tremendous benefit to NASA and other organizations. The use of acoustics in NDE also enhances safety when compared to other types of NDE. The proposed inspection system could become an important tool in all additive manufacturing operations including NDE/NDT, Certification, Process Monitoring, Damage Detection, and Meeting Specification.

Additive manufacturing is widespread in industry. This system will expand industrial applications to where component mechanical properties and certification are extremely important. By providing a procedure with which printed parts can be quickly confirmed as meeting preset criteria, significant cost reduction is possible. Applications include all of the above and detection and prevention of counterfeiting and tampering detection and monitoring/inspecting coatings.



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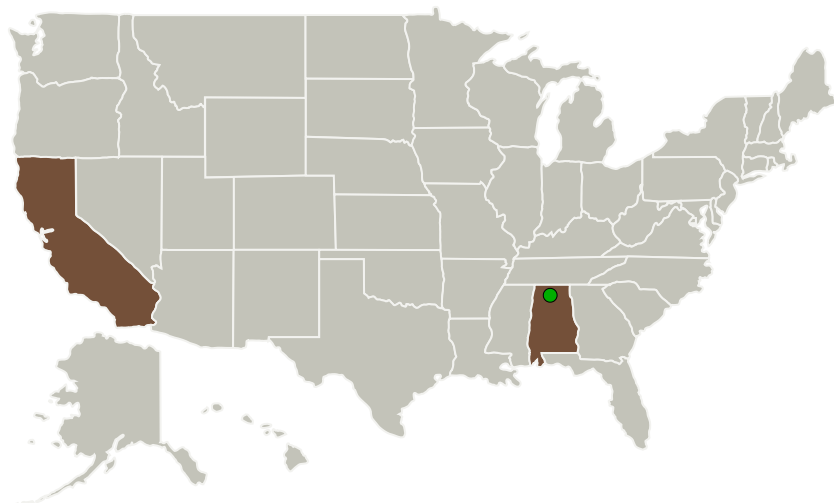
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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
MetroLaser, Inc.	Lead Organization	Industry Minority-Owned Business, Small Disadvantaged Business (SDB)	Laguna Hills, California
● Marshall Space Flight Center (MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations

Alabama	California
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Project Transitions

July 2018: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

MetroLaser, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

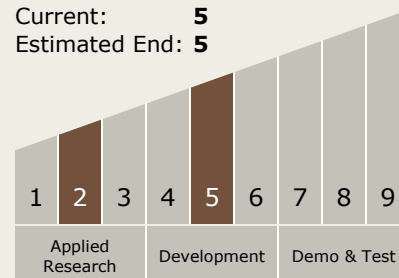
Carlos Torrez

Principal Investigator:

James D Trolinger

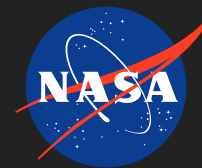
Technology Maturity (TRL)

Start: 2
Current: 5
Estimated End: 5



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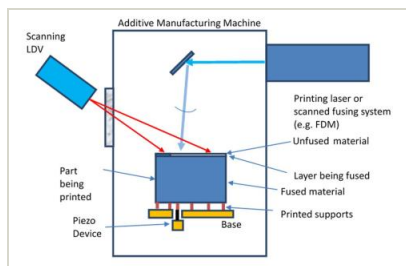


✓ **February 2019:** Closed out

Closeout Documentation:

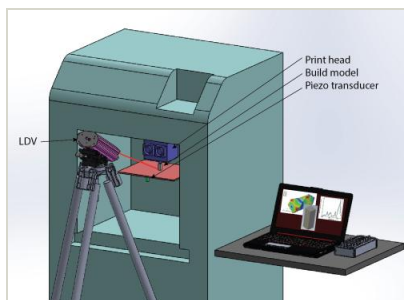
- Final Summary Chart(<https://techport.nasa.gov/file/141207>)

Images



Briefing Chart Image

Acoustical Signature Analysis for In-Situ Monitoring and Quality Control for In-Space Additive Manufacturing, Phase I
(<https://techport.nasa.gov/image/135104>)



Final Summary Chart Image

Acoustical Signature Analysis for In-Situ Monitoring and Quality Control for In-Space Additive Manufacturing, Phase I
(<https://techport.nasa.gov/image/129969>)

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - └ TX12.4 Manufacturing
 - └ TX12.4.2 Intelligent Integrated Manufacturing

Target Destinations

Earth, The Moon, Mars